Interagency Ecological Studies Program for the Sacramento-San Joaquin Estuary

NEWSLETTER

Summer 1993

Readers are encouraged to submit brief articles or ideas for articles. Correspondence, including requests for changes in the mailing list, should be addressed to Randy Brown, California Department of Water Resources, 3251 S Street, Sacramento, CA 95816-7017.

End of an Era
Randy Brown, DWR

Pete Chadwick is retiring from state service on July 31. For as long as most of us have worked on California water issues, Pete has been the spokesman for the California Department of Fish and Game in matters related to Bay/Delta fisheries. The diversity of backgrounds — from water folks to fish folks — at his recent retirement luncheon demonstrated the esteem in which Pete is held by all members of California's generally contentious water community.

Pete grew up on the East Coast and studied fisheries at Cornell and the University of Michigan. He began working for DFG in 1956 and, for about 10 years, held a variety of positions in Inland Fisheries, including 4-plus years as project leader for the Bay/Delta striped bass research program. During this period, Pete was involved primarily in the technical side of biology, and his many accomplishments include the capture (and preservation) of the last recorded thicktail chub from California and bringing white bass to the state.

Since 1966, Pete has been in charge of investigations to determine how water projects affect the environmental resources of the Bay and Delta. Recently, his position title has been Chief of the Bay/Delta and Special Water Projects Division.

Although it is generally true that no one is irreplaceable, some are more difficult to replace than others. Pete Chadwick is one of those who will be difficult to replace. Although he will be returning as a retired annuitant for up to one-fourth time, it will

Pete Chadwick back in the field days.

not be the same. I suspect there will be a plethora of bidders for the relatively few hours Pete will be working after returning from his vacation along the Amazon. I will be one of them.

I speak for us all in thanking Pete for his help in attempting to resolve the Bay/Delta water issues and in wishing him well in semi-retirement. The following pages contain some thoughts, comments, and recollections from a few of the people who have worked with Pete over the years.

CONTENTS

Pete Chadwick is the epitome of a public servant.
Never, never did you convey to me that either you or your views were infallible.
You spoke slowly and clearly about Bay/Delta problems and solutions.
You were a strong advocate for protecting the biological integrity of the Bay and Delta.
However, you did not ignore the overall importance of that water body to all of California and to its inhabitants.
I hold you in high regard and am sorry to hear that you have decided to retire.

Don Maughan, Retired Chair, State Water Resources Control Board

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You and I have been friends and colleagues for over 30 years. In that time, I cannot remember you ever being anything but helpful, willing to share ideas and the vast amount of information your staff has gathered, and willing to argue for objective science, no matter what the politics.

You and your staff have made many major contributions to estuarine research, but you have one major task left to do. I urge you to write a history of what has happened in the estuary. Why, with major funding and a team of the finest scientists, did we not save the fisheries resources? This is a story only you can write. You are the only one who was close to both research and politics throughout the whole period. California needs your analytical, mind, objectivity, and well-deserved reputation for fairness and integrity for this one last task.

Don Kelley

I've enjoyed the 13+ years that we've worked closely together.
The PC, the Four Pumps, Hood, 1485 Triennial Reviews, Bay/Delta-1630, white bass in Tulare, winter-run, the law suits ....
The past years have never been boring, have they?
I hope that you and your wife enjoy your retirement — you certainly deserve it.

Kindest regards,
Roger S. C. Wolcott, Jr.
National Marine Fisheries Service
Southwest Region, HCD

Your abilities to mediate controversial situations are impressive.
Your talent for closing your eyes at meetings after lunch and then opening them to ask an especially relevant and penetrating question are legendary ("How does he do that?").

It has been a pleasure to work with you.
I wish you and your wife the best as you each prepare to retire to a less structured but equally (or more) rewarding lifestyle.

Regards,
Webb Van Winkle
Oak Ridge National Laboratory

You have had a profound and positive effect on both sides of the table — the fish and wildlife management side and the water development side. You have done this through your tireless ability to explore and offer solutions to the complex and conflicting issues of water development and fisheries management. You have demonstrated a keen awareness of the water issues while at the same time maintaining an expert's command of the fine points of biology. Consequently, you have brought a level of understanding to many of us that would never have occurred had you not been traveling the same road with us.

We will all miss you, Pete. We sincerely extend to you from the entire staff of the Bureau of Reclamation, wishes for a long and happy retirement.

Roger K. Patterson
U.S. Bureau of Reclamation

Sometime in January of 1984, after a lengthy briefing by DWR engineers regarding Governor Deukmejian's proposed through-delta project, later to be dubbed "Duke's Ditch", I realized I was in trouble because I was beginning to understand and trust Bob Potter. As the green lobbyist for sport and commercial fishing interests, who could innocently say "Peripheral Canal" in mixed company and wonder why people like Stan Barnes, Jerry Meral, and Dave Kennedy quickly changed the subject, I seized upon Pete Chadwick so he could assure me that the delta fisheries would be protected by merely flushing millions of gallons of Sacramento River water down the Mokelumne River. Pete paused, pushed his glasses back on the bridge of his nose, leaned back on the edge of a table, straightened his tie, rubbed his chin, looked up and then down, and finally, seeing that I really wanted an answer, he told me the truth: "There aren't any simple solutions to the delta no matter how well-meaning the DWR engineers are."

Through the years I learned that Pete Chadwick had one of the toughest jobs in state government. He had to be Larry Mullnix, Jerry Cox, and Bob Potter's wet blanket during a time when everyone wanted DFG to agree to a simple solution.

Bill Yeates, Attorney, Remy and Thomas

Pete, you are
one of those people
all the rest of us look up to
— not for any particular accomplishment,
but for your overall approach to
work and dealing with people.
You brought to the Delta issues
a rare combination of balanced judgment,
comprehensive knowledge, hard work, and
genuine manner.
Everyone involved in the Delta and estuary has
benefited from your contributions.

David N. Kennedy, Director
Department of Water Resources

No one has done more to
reduce and reverse the harmful effects of
water development in the Delta than
Pete Chadwick.

Under both environmentally sympathetic and
hostile administrations, you have remained
firm in your commitment to restoring
Delta environmental quality, and
you have honestly presented the
best scientific case for fisheries restoration.
Your efforts have made it possible to
look forward to the day
when restoration will take place.

Best personal regards,
Gerald H. Meral, Executive Director
Planning and Conservation League

You brought a wealth of skills and experience to the SFEP.
As a leader of the Management Committee, you set a standard for
diplomacy and always remained alert for opportunities for consensus.
As a participant on the various subcommittees dealing with
aquatic resources, you offered technical insights that could be applied
directly to improved management of the estuarine environment.
Also, you were hero to the SFEP staff; we could always count on you for
assistance in planning and executing important meetings.
We are grateful for your dedication to public service and your
immense contribution to the development of the
Comprehensive Conservation and Management Plan.

Amy K. Zimpfer
San Francisco Estuary Project

Continuous Flow Measurements Using Fixed Ultrasonic Meters

Rick Oltman, USGS

USGS has or soon will be installing four continuous flow-monitoring stations in the delta that will use ultrasonic velocity meters (UVM). Funding for the stations has been provided by USGS, DWR, USBR, and Contra Costa Water District.

Two of the UVM stations are on the Sacramento River near Walnut Grove, one upstream of the Delta Cross Channel, and the other downstream of Georgiana Slough. The difference in the two records will provide a measure of delta transfer flow (Georgiana Slough flow will be provided if the Delta Cross Channel gates are closed). The difference between the flow record produced by the existing UVM on the Sacramento River at Freeport and the station upstream of Walnut Grove will provide a measure of flow down Sutter and Steamboat sloughs. Both of the Walnut Grove stations have been collecting data since January 1993, and a few flow measurements have been made for use in calibration, but the meters have not yet been calibrated.

A third UVM station has been installed on the San Joaquin River at Jersey Point and has been operating periodically since the second week in June. This station is a step up in complexity relative to the Walnut Grove stations because transducer transmission cables cannot be laid across the channel bottom to link the transducers with the UVM hardware. To overcome this limitation, the site is equipped with 4 transducers, 1 UVM, and 1 responder, which acoustically links the 2 transducers on one side of the channel with the 2 on the other side. This station will monitor flows in the lower San Joaquin River and, when summed with data from the fourth UVM station (described below) and with flow estimates for Dutch Slough (which will be based on measured flows at Jersey Point), will provide a better estimate of delta outflow than now exists.

The fourth UVM station will be on the Sacramento River downstream of Decker Island. This site will be another step up in complexity above the Jersey Point station because two Jersey Point-type installations will be required to span the 3,000-foot-wide channel. The installation will also require use of a radio link to prevent the two independent UVM systems from interfering with each other. Installation of this station will begin once the Jersey Point site has been debugged and demonstrates that the equipment can adequately handle the acoustic path lengths at that site. The length of the acoustic path across the channel between pairs of transducers is a limiting factor. Jersey Point is approaching that limit, and the Decker Island station will be longer than Jersey Point.

USGS is working with the cities of Tracy and Stockton on the installation and calibration of their UVMs on Old River and the San Joaquin River, respectively. Both sites may be operational by fall. The cities are required to monitor streamflow at their discharge points as part of their National Pollutant Discharge Elimination System permit. USGS hopes to obtain additional funding to install a UVM station on Threemile Slough. The data from this station, in conjunction with the data from the Jersey Point station and its relationship for Dutch Slough flows, would provide a better estimate of the reverse flow index, QWEST, than now exists.

In addition to uses mentioned above, data produced by the UVMs will be used for calibration and validation of models and will provide insight into the filling and draining of the delta over the spring/neap tidal cycle.

Particle Track Model for the Delta

Francis Chung, DWR

A computer model has been developed to simulate the movement and fate of particles in the delta. What makes this model different from other estuary models is that it tracks particles individually, allowing a number of possible applications. One initial applications is to simulate movement of fish eggs and larvae. Movement, growth rate, and mortality rate of an individual egg or larva can be individually simulated at locations throughout the estuary. The output of such simulations can be very useful. For example, for the amount of mass entrained in the project pumps, it is possible to determine the individual path taken by each entrained particle. This type of information can easily lead to different physical and operational alternatives to minimize such entrainment.

With the help of the developed model, the paths of particles from any location in the delta to any destination can be investigated. The path will depend on local hydraulics and operational modifications. This is useful in studying the fate of eggs spawned at various locations in the estuary. If the desired destination of the mass is known, hydrologic and operational

variations can be tested to help find the best management scheme.

The fate of a particle over time, if known, can also be simulated with this model. This means predation, mortality, or growth characteristics over time and space can be simulated, but data for these processes are limited.

Three basic factors responsible for delta transport processes are advection, dispersion, and channel braiding. Advection is the tendency of a particle to move with the flow. Dispersion is largely caused by turbulence, which causes a particle to move perpendicular to flow lines. The braided nature of delta channels enhances mixing by allowing particles to separate at channel junctions.

So far, studies have used data for striped bass eggs and larvae, since that is the largest database. Data being used for calibration and verification of the model are travel time, stratification, mortality, and egg characteristics. Travel time data have been taken "continuously" (every few hours) at various locations in the delta. Using these data, the travel time of a pulse of eggs relative to flow in the channel can be determined and used in model calibration. The data also show attenuation of the pulse peaks as measured downstream. This can help determine the rate of mortality. Stratification data are taken at various depths in the water column at various locations in the delta. These data can be used to determine the vertical distribution of eggs and larvae under certain flows. If cross sectional data are also taken, then the proportion of particles moving down a channel at a junction can be investigated. Mortality data are any field data that indicate a mortality pattern. Characteristic data for eggs and larvae, such as settling rate, are used to calibrate the vertical distribution of eggs and larvae.

Future data collection efforts can also benefit from this new model, because it can be used to identify the optimal space and timing of data collection.

Reproduction and Artificial Propagation of Delta Smelt, *Hypomesus transpacificus*
Randy Mager, Department of Animal Science, University of California, Davis

Delta smelt has recently declined in abundance and has been declared a threatened species. Our project, supported by DWR and USBR, aims to explain the reproductive biology of smelt and develop a laboratory-scale artificial breeding system capable of producing early life stages for experimental research and conservation. We collaborate with DFG researchers in broodstock procurement and field observations.

Collected data suggest the breeding stock of wild smelt consists primarily of 1-year-old fish. The gonadal cycles (ovarian vitellogenesis and testicular meiosis) occur about 2 or 3 months before spawning. Spawning occurs from late February through May, at river temperatures of 14-18°C. Fertilized eggs attach to substrate by an adhesive "foot" (the inverted outer layer of chorion). Hatching occurs 10 to 14 days after fertilization, and exogenous feeding starts 6 days after hatching. In the laboratory, larvae consumed phytoplankton and rotifers at the onset of feeding, followed after 2 weeks by *Artemia* nauplii.

First captive reproduction of delta smelt was achieved by Dr. Joan Lindberg and by our laboratory in 1992 using natural tank spawning, as well as by stripping and *in vitro* insemination of eggs from ripe fish caught on spawning grounds. Only a limited number of larvae were produced, and they did not survive beyond 38 days. Major problems were unreliable supply and poor spawning performance of ripe fish due to capture stress imposed at the most sensitive phase of the reproductive cycle.

In the second year of the project, we caught 150 wild immature fish and raised them in the laboratory for 5 months. They were fed an artificial diet, and gonadal development was controlled by artificial temperature and photoperiod regime. By April, all fish had completed normal gonadal cycle. However, one week before spawning trials, the broodstock suffered severe infection of the bacillum *Mycobacterium* sp. Spawning induction was achieved by the immersion of fish in LHRH-A bath, but ovulated eggs were infertile. Broodstock colony was eradicated after spawning.

Mycobacterium disease is considered incurable in aquatic animals, and the wild stock is believed to be the most probable source of infection. We plan to develop a new broodstock management system that should prevent or minimize the impact of disease. This will involve screening wild fish for infection, raising isolated colonies in multiple rearing units, and monitoring infection in captive fish. The Fish Diseases Laboratory, School of Veterinary Medicine, will collaborate in this project. This system will provide reproductively functional colonies for breeding, through which all life stages of smelt can be reliably available for research without disturbing the threatened wild population.

Suisun Marsh Fish Sampling

Lesa Meng, University of California, Davis

The UC-Davis fisheries group began monthly fish sampling in Suisun Marsh in 1979. The program consists of otter trawl collections and some seining and midwater trawling at 17 stations scattered throughout the marsh. We sample two habitat types. Of the seven sloughs sampled, five are categorized as small, dead-end sloughs; the others are 10 times as wide, 2-3 times as deep, partially riprapped, and are categorized as larger sloughs. The first 5 years of data are summarized by Moyle *et al* (1986), who noted a general downward trend in fish abundance and species diversity. Moyle *et al* also noted that fish community composition was fairly consistent through time and comprised three groups: native species in small, dead-end sloughs; introduced fishes in larger sloughs; and fishes that appear in the marsh seasonally.

Recent analysis indicates changes in the abundance and distribution of Suisun Marsh fishes. A repeated-measures analysis indicates a significant decline in fish abundance over the 14-year study period (Figure 1). Native species were more common in dead-end sloughs, and seasonal fishes were more common in larger sloughs. Introduced species were common in both habitat types. The most consistent trend among native, introduced, and seasonal fishes was the decline of native fishes in dead-end sloughs. A Spearman rank correlation indicated the decline in fish abundance and species diversity was associated with increasing salinity and decreasing freshwater outflow. *Neomysis mercedis* and *Palaemon macrodactylus* also declined over time and were correlated with decreasing fish abundance and species diversity. *Crangon franciscorum* did not decline over time and was not correlated with fish abundance and species diversity.

Results of a principal components analysis indicated composition of the fish assemblage had lost its predictability. The PCA identified mixed groups of native and introduced species with similar freshwater and seasonal needs, in contrast to results of the earlier study, which found distinct groups of native, introduced, and seasonal species. Moreover, many species switched groups between the two analyses, which indicated fish were occurring in the marsh in different patterns than before.

Chameleon goby and yellowfin goby showed different patterns of invasion and abundance in the marsh (Figure 2). Both gobies were introduced into the Delta in the late 1950s, and by 1980 yellowfin goby was the third most abundant fish in our trawls. We caught our first chameleon goby in 1985, but they did not become abundant until 1988; by 1989 they were the most abundant fish in our trawls. We hypothesize that increasing salinities coupled with the flushing flows of 1986 allowed the chameleon to invade. Recently, chameleon goby numbers have declined in the marsh.

Reference

Moyle, PB, RA Daniels, B Herbold, and DM Baltz. 1986. Patterns in the distribution and abundance of a non-coevolved assemblage of estuarine fishes. *Fishery Bulletin* 84:105-117.
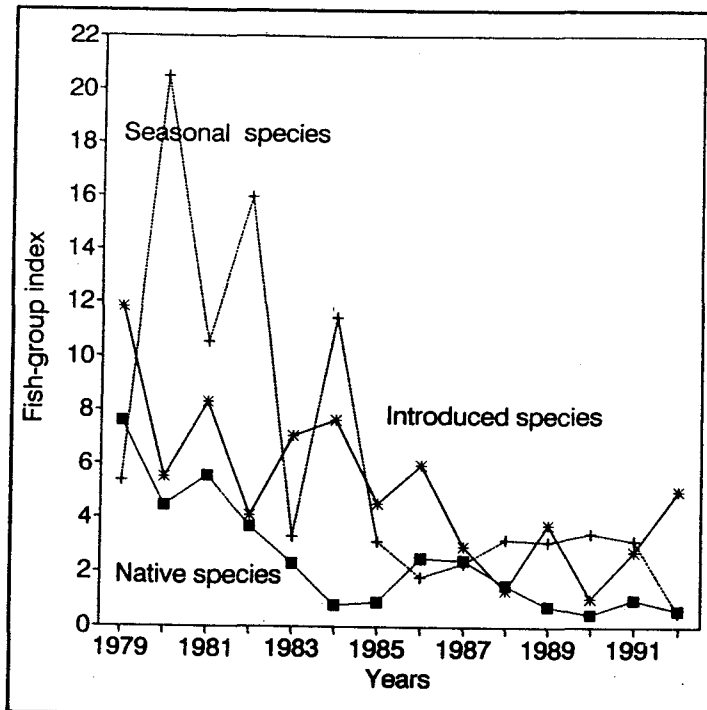

Figure 1
ABUNDANCE OF
INTRODUCED, NATIVE, AND SEASONAL FISH GROUPS
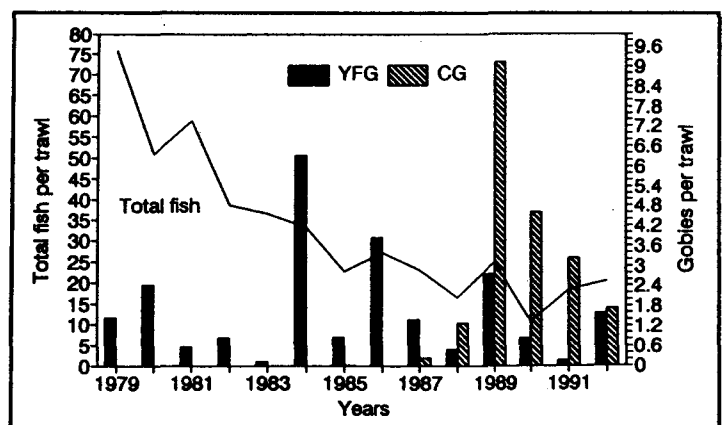VERSUS TIME

Figure 2
CHAMELEON GOBY, YELLOWFIN GOBY, AND
TOTAL FISH ABUNDANCE VERSUS TIME
(Data are fish per trawl.)

A Note on the Physical Significance of X_2

Stephen Monismith
Environmental Fluid Mechanics Laboratory
Stanford University

In 1991 and 1992, the EPA San Francisco Estuary Project convened a series of workshops to evaluate the responses of estuarine biota and habitats to various conditions of salinity and flow. A major outcome of the workshops was the recommendation that X_2, the distance along the river channel from the Golden Gate Bridge to the point where the near-bottom salinity is 2 ppt, is a good index upon which estuarine standards should be developed (Schubel *et al* 1993).

As noted in the EPA report on workshop findings and in previous work reported in Williams and Hollibaugh (1987), X_2 depends primarily on delta outflow and tidal phase. For example, X_2 can vary between 50 kilometers for $Q = 10^5$ cfs to 100 km for $Q = 10^3$ cfs (Kimmerer and Monismith 1992). Superimposed on this range of flow-induced variability is a tidal variation of as much as 10 kilometers within a 12.4-hour M_2 tidal period. During and after the workshops, there has been substantial discussion about the significance of X_2. The purpose of this note is to show that X_2 is a good length-scale for measuring the spatial structure of the salt field in northern San Francisco Bay.

To determine the extent to which the longitudinal variation in salinity depends on X_2, I looked at the CTD data collected by USGS in its North Bay cruises from January 1990 through February 1992 (documented in USGS Open File reports). The dataset spans a range of X_2 of 58 to 90 kilometers. These data are derived from casts made with a Sea-Bird CTD and

are given in practical salinity units rather than parts per thousand. For the range of salinities found in San Francisco Bay, these are nearly identical.

I extracted top, bottom, and mean (depth-averaged) salinities for each of the CTD stations. I made no attempt to correct the salinity measurements for tidal variations. From the bottom salinity measurements, I estimated X_2 by linearly interpolating position between the two stations for which the bottom salinities bracketed 2 psu.

Figure 1 plots mean salinities as a function of X. Figure 2 plots the same quantity as a function of X/X_2. Here X is the measured distance from the Golden Gate. Comparing these figures, it is apparent that to within scatter (probably) primarily induced by tidal variations, it is apparent that X_2 is a good flow-related scale for the salinity field in that it nearly "collapses" the data about an equilibrium mean salinity distribution. The scatter apparent is at a maximum for X/X_2 near 0.5; the rms variation in mean salinity in this region is about 2 psu if X/X_2 is held constant or 0.05 X_2 if salinity is fixed.

For the range of flows encountered in this dataset, the scatter remaining in Figure 2 does not appear to be related to flow. Figure 3 shows the scaled versions of the two transects with the smallest (day 92098 - 58.5 km) and largest (day 91344 - 89.7 km) values of X_2. Other than the slightly lower salinities near the Golden Gate for the higher flow condition (92098), there is little difference between the two curves.
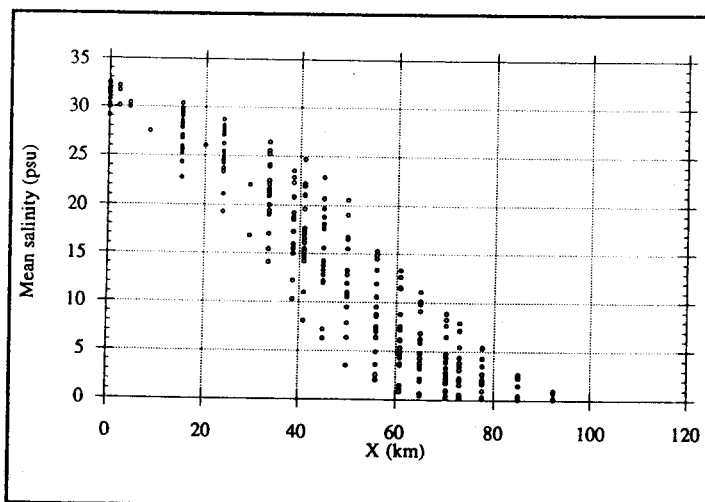

Figure 1
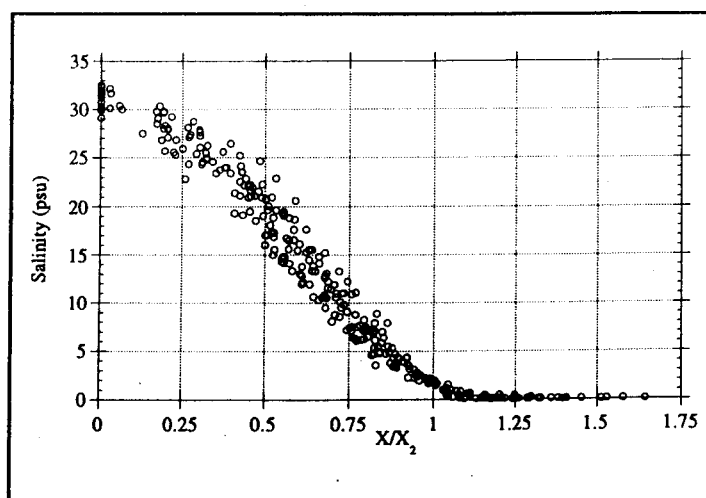MEAN SALINITY AS A FUNCTION OF X
(1990-1992 USGS Data)

Figure 2
MEAN SALINITY AS A FUNCTION OF X/X_2
(1990-1992 USGS Data)

One question that arose during the EPA workshops was that of the dependence of results on the seemingly arbitrary choice of a particular bottom salinity. Given that the scaling works especially well for low salinities (S <4 psu), any similar length scale based on the position of the, say, 1 or 3 psu bottom isohaline would probably be equivalent to X_2. For example, a plot (not shown) of mean salinity as a function of the surface, rather than bottom, location of the 2-psu isohaline is essentially identical to Figure 2.

Figure 4 is a plot of the top:bottom salinity difference as a function of X/X_2. This figure shows clearly that downstream of X_2 there is often significant salinity stratification, whereas upstream of X_2 there is little stratification. In particular, the water column was stratified during all of the 1990-1992 cruises for $0.4 <X/X_2 <0.7$. In this section of the estuary, salinity differences as large as 6 psu were not unusual, although the mean is roughly 2 psu.

The reason for the strong stratification downstream of X_2 is the fact that X_2 is a good dividing point between a downstream reach in which salinity varies almost linearly with distance and a region in which salinity is almost constant (see Figure 2). This is important in that the mean salinity gradient gives rise to a baroclinic pressure gradient that drives gravitational circulation which, in turn, leads to density stratification. The stronger the baroclinic pressure gradient, the more likely it is that stratification will develop. In terms of traditional models of the entrapment zone / estuarine turbidity maximum (eg, Arthur and Ball 1978), it is apparent that X_2 is a good measure of where — at least in the channel — the tidally averaged flow makes the transition from a purely barotropic, uni-directional, downstream flow

to a bi-directional baroclinic flow (though still with net downstream flow).

Figure 2 can be used to quantify the baroclinic pressure gradient associated with the longitudinal salinity gradient. Where $0.3 <X/X_2 <0.9$, this salinity gradient is about 37.5 psu/X_2 . In terms of the depth-averaged pressure gradient that results, for a 10-meter-deep water column, this is equivalent to a free-surface slope of

$$\frac{\partial \eta}{\partial x} = \frac{1.3 \times 10^{-4}}{X_2} \tag{1}$$

if X_2 is given in kilometers. For example, with $X_2 = 75$ km (Chipps Island), this gives an effective surface slope of 1.8×10^{-6}. With $X_2 = 50$ km, the effective slope is 2.7×10^{-6}, that is, 50 percent larger. In comparison, typical tidal pressure gradients in Suisun Bay have maximum surface slopes about 1×10^{-5}. Thus, as others have argued (eg, Smith and Cheng 1987), the baroclinic pressure gradients observed downstream of X_2 are dynamically significant and increase monotonically with delta outflow.

The effects on salinity dynamics of the magnitude of baroclinic pressure gradient given by equation (1) can be substantial. Using a 1-dimensional model of tidal hydrodynamics similar to that described by Simpson and Sharples (1991), Mark Stacey and I found that salinity gradients comparable to those given in the preceding paragraph lead (at least in the model) to "run-away" stratification — a water column consisting of fresh water that overlies ocean water. The reason is that the effect of stratification on vertical mixing is so severe that mixing is unable to keep up with the stratifying effect of advection. Given that in reality the average top:bottom salinity difference is
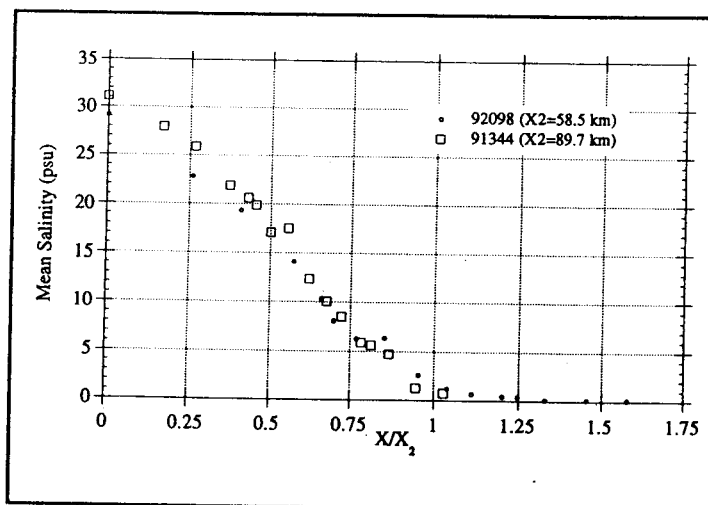

Figure 3
MEAN SALINITY AS A FUNCTION OF X/X_2 FOR TWO TRANSECTS
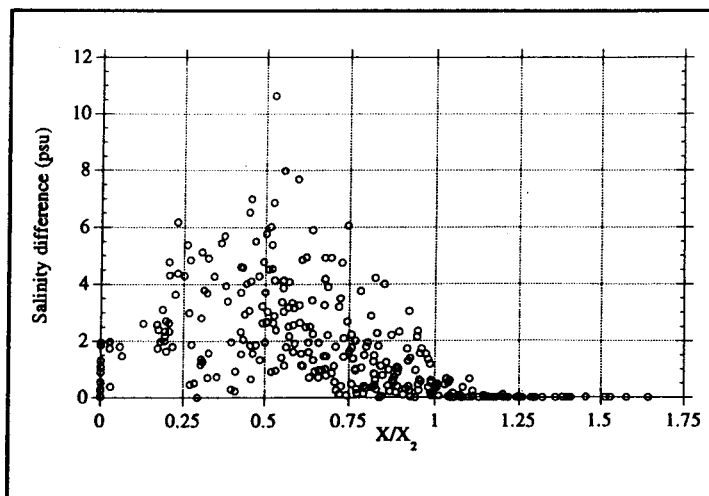(1990-1992 USGS Data)

Figure 4
TOP/BOTTOM SALINITY DIFFERENCE AS A FUNCTION OF X/X_2
(1990-1992 USGS Data)

roughly 2 psu (not 35 psu), horizontal exchanges between the shoals and channels in Suisun Bay must play an important role in the salt balance. In any event, the lack of stratification upstream of X_2 shown in Figure 4 is evidently a consequence of the lack of significant baroclinic pressure gradients for $X > X_2$.

It appears the following conclusions can be drawn from examination of the USGS 1990-1992 CTD data for the northern reach of San Francisco Bay:

- X_2 is a useful length-scale for parameterizing the spatial structure of the salt field in northern San Francisco Bay. For a given value of X_2, the location of any other isohaline can be estimated with an accuracy of about 5 percent of X_2 or, given a particular value of X/X_2, the depth-averaged salinity can be estimated to about 2 psu. Given that salinity is an important habitat characteristic for many estuarine species and the strong dependence of X_2 on flow, X_2 may be useful in parameterizing how estuarine habitat is linked to flow.

- From a hydrodynamic standpoint, X_2 also describes the boundary between a downstream reach of the estuary in which strong baroclinic pressure gradients and density stratification are observed from an upstream reach in which they are quite weak. For these reasons, in the light of the traditional

model for entrapment zone dynamics, X_2 should be a good measure of entrapment location. Moreover, given the substantial effects of density stratification on vertical mixing and, thus, on benthic/pelagic coupling (see, for example, Koseff et al 1933), it would appear that X_2 may also separate regions having quite different and ecologically significant physical characteristics.

Among the interesting questions that remain:

- Given the large degree of flow variability inherent to flows into San Francisco Bay, why do we generally observe a nearly equilibrium salinity field?

The 1986 CTD transects taken by the USGS and USBR during the large flows in February and March 1986 show salinity distributions that were significantly fresher over most of the bay than were observed in the data discussed here, leading us to ask:

- When is the salt field significantly not in equilibrium?

One can hypothesize that the answer to both questions may lie in the way bathymetrically induced variations in tidal motions couple the shoals and channels in northern San Francisco Bay and in the way this coupling is affected by large freshwater flows.

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Williams, P.B., and J.T. Hollibaugh (1987). *A Salinity Standard to Maximize Phytoplankton Abundance by Positioning the Entrapment Zone in Suisun Bay*. Philip Williams and Associates Report 412-4.

Delta Flows

The figures below illustrate delta inflows and outflows and project pumping so far during water year 1993. Flood control releases resulted in high flows in June, a peak of 48,700 cfs in the Sacramento River. Delta inflows in July were about twice that in July 1992.
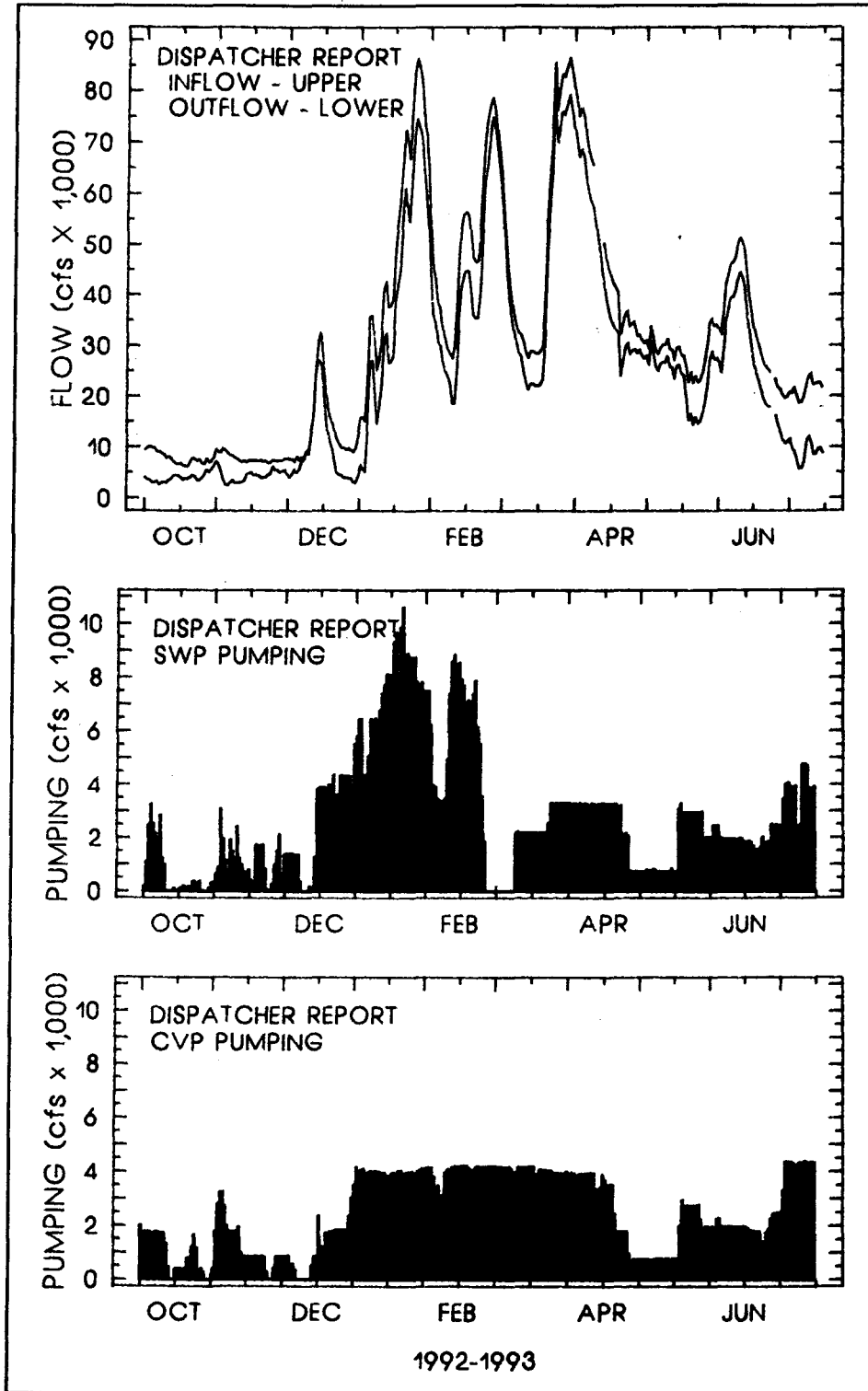
Delta Smelt

On April 5, USFWS listed the delta smelt as threatened under the federal Endangered Species Act. On June 17, the California Fish and Game Commission decided to list the smelt as threatened under the state ESA. Actual listing will occur later this summer.

On May 26 USFWS released its biological opinion on the effect of operation of the SWP and CVP on delta smelt. To avoid a jeopardy opinion, DWR and USBR agreed to operate to meet QWEST and other criteria through July. USFWS rather unexpectedly added a 400-fish daily take limit and reverse flow criteria for August. The opinion is for 1993 and the first two months of 1994. The agencies are working on a biological assessment, which will provide the basis of the next biological opinion. Due to the relatively short time to complete a complex consultation, it isn't clear yet if the next opinion will be for one year or for the long term.

The 1993 delta smelt tow-net index is 8.2. Although this is the highest index since 1982, it was greatly increased by a high catch of smelt at one station in the lower Sacramento River near the western end of Sherman Island. The fall mid-water trawl survey, which begins in September, should provide a better estimate of the strength of the 1993 year class.

Noteworthy —

→San Luis and Delta-Mendota Water Authority, in conjunction with the Interagency Program, recently completed the field portion of an evaluation of the effectiveness of an acoustic barrier for preventing juvenile Chinook salmon outmigrants from entering Georgiana Slough from the Sacramento River. Chuck Hanson, the Authority's principal fisheries consultant, expects the final report to be available in August. Preliminary results indicate acoustic signals reduced the percentage of juvenile fall Chinook entering Georgiana Slough. For information related to this study, please contact Chuck at 510/942-3133.

→In April, NOAA sponsored a workshop to discuss exotic species in the estuarine environment. Researchers from Europe, Australia, and North America discussed problems caused by these mostly accidental introductions. Problems ranged from food chain disruption (*eg,* comb jellies in the Black Sea) to water supply impacts (*eg,* Zebra mussel in the Great Lakes) to health concerns caused by infectious agents in near-shore waters of Australia. Joel Hedgpeth made the keynote speech. The principal cause of the problem appears to be ballast water taken on in one estuary and discharged to an estuary in a different part of the world. The focus of control efforts will be to eliminate or reduce this practice. Speakers were not optimistic that established accidental or purposeful introductions could be controlled.

→In June, investigators from New York, South Carolina, California, the Electric Power Research Institute, and Oak Ridge National Laboratory met in New York to review the individual based striped bass model being developed by staff at Oak Ridge. Working models have been developed for the Hudson Bay/Delta bass populations. Researchers reviewed the data used to develop the models and discussed preliminary results of model runs. The next step will be to provide the model codes to each working group and let them begin to use the model to play "what if" games. Interagency staff may travel to Oak Ridge to work with the modelers to learn the intricacies of the model code. As now written, the model is not particularly "user friendly".

→Although the 1993 striped bass tow-net index has not been quite set yet, early results have been encouraging. The index was 46.2 for the first survey and dropped to 34.8 for the second survey. The mean length of juvenile bass in the second survey was 33.6 mm and was expected to reach 38.5 mm by July 15. (The index is set when the average size of striped bass captured in the tow-net reaches 38.5 mm.) The third survey is scheduled for the week of July 22. The index for the second survey was increased greatly by a catch of 203 striped bass, which accounted for an index of 10.6 by itself. It appears that the 1993 index will be the highest since 1986.

→This spring and summer, DFG and DWR egg and larval samplers were plagued by an extensive bloom of *Melosira granulata.* The bloom persisted for several weeks and resulted in tow time being cut from the typical 10 minutes to 1-2 minutes. Even with the short tow times, the nets clogged and the collected algal mass made preservation and sorting more difficult.

Interagency Program Revision

On July 20, Interagency Deputy Directors met with Coordinators and staff to discuss the revision team's recommendations for reorganizing the program. The basic recommendation was for approval of an organizational structure including formation of an interim staff-level management team. The interim team would then proceed with detailed planning needed to flesh out the organization and develop recommendations for changes in the technical program. The Deputies approved this approach, and staff will now proceed with the reorganization. Staff is planning to have detailed recommendations for Director approval in November 1993 (phase 2), with implementation in January 1994 (phase 3).

This reorganization will fundamentally change the way the Interagency Program fulfills our mission and achieves our objectives. Some of the key changes are:

- Much of the day-to-day decision-making will be delegated to the program manager and staff management committee.

- Formal technical committees will be replaced by small working groups that will focus on specific technical questions.

- Agency Coordinators will meet less frequently and work on broader program issues.

- The Agency Deputy Director level will meet quarterly to provide most of the policy input.

- A concerted effort will be made to seek input from outside experts and staff from the participating agencies who are not part of the Interagency Program (*eg,* the regulatory staff of USFWS).

- Information collected through the program will be easier to obtain than it has been in the past.

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